<u>WHAT IS CLAIMED IS</u>:

1. A method for producing direct reduced iron DRI or prereduced iron ore with improved reducing gas utilization, comprising:

feeding a stream of reducing gas mainly composed of hydrogen and carbon monoxide and also comprising methane, carbon dioxide and water, heated at a temperature between about 750°C to about 1050°C, to a reduction zone within a reduction reactor wherein solid particles containing iron oxides present therein are reduced by reaction of said iron oxides with said reducing gas;

withdrawing from said reactor said reducing gas after reacting with said iron oxides as top gas;

cooling and cleaning said top gas and removing water therefrom to produce a cooled top gas;

heating and recycling a first portion of said cooled top gas to said reduction reactor as part of said stream of reducing gas;

purging a second portion of said cooled top gas;

adding make-up gas to gases eventually recycled to the reducing zone;

separating from said second portion of said cooled top gas at least the majority of the hydrogen contained therein to form a hydrogen rich gas stream which is lean in carbon dioxide, and

recycling said hydrogen rich gas stream to said reduction reactor.

2. A method according to claim 1, wherein said hydrogen rich gas stream has substantially no carbon dioxide and has significantly less nitrogen relative to said second portion.

3. A method according to claim 1, wherein the separation of H_2 from said second portion of said cooled top gas is made in a PSA or a VPSA adsorption unit.

4. A method according to claim 1, wherein the separation of H_2 from said second portion of said cooled top gas is made in a CO_2 chemical absorption unit.

5. A method according to claim 3, wherein said hydrogen rich gas stream has an hydrogen content equal to or higher than 92% in volume.

6. A method according to claim 3, wherein said hydrogen rich gas stream has an hydrogen content equal to or higher than 95% in volume.

7. A method according to claim 5, further comprising producing a reducing gas as the make-up gas in a steam-natural gas reformer; combining said make-up reducing gas with said first portion of said reducing gas; heating the combination of the first portion and the make up gas to a temperature higher than 750°C and introducing it to said reduction zone.

8. A method according to claim 5, further comprising combining as the make up gas a natural gas stream or another reformable hydrocarbon, with said first portion of said cooled top gas; circulating such combination through a CO_2-natural gas

reformer thereby producing said stream of reducing gas and introducing said stream of reducing gas to said reduction zone.

9. A method according to claim 5, further comprising combining as the make up gas a humidified natural gas stream with said cooled top gas stream and heating said combined stream to form said stream of reducing gas stream, whereby the natural gas present in the reducing gas fed to the reduction zone is largely reformed within the reduction zone taking advantage of the catalytic action of the metallic iron within said reduction reactor.

10. A method according to claim 7, further comprising injecting an oxygen or air enriched with oxygen stream to the stream of reducing gas prior to its introduction to said reduction reactor.

11. A method according to claim 8, further comprising injecting an oxygen or air enriched with oxygen stream to the stream of reducing gas prior to its introduction to said reduction reactor.

12. A method according to claim 9, further comprising injecting an oxygen or air enriched with oxygen stream to the stream of reducing gas prior to its introduction to said reduction reactor.

13. A method according to claim 10, wherein said oxygen or air enriched with oxygen stream has an oxygen content higher than 30% in volume.

14. A method according to claim 11, wherein said oxygen or air enriched with oxygen stream has an oxygen content higher than 30% in volume.

15. A method according to claim 12, wherein said oxygen or air enriched with oxygen stream has an oxygen content higher than 30% in volume.

16. A method according to claim 5, further comprising combining hydrogen rich gas stream, with said reducing gas stream and introducing said combination to said reduction zone.

17. A method according to claim 12, further comprising heating said hydrogen rich gas stream in a separate heater separate from any prior to its introduction to said reduction zone.

18. A method according to claim 5, further comprising feeding said hydrogen gas stream to a cooling zone of said reduction reactor.

19. A method according to claim 5, further comprising feeding natural gas to a cooling zone of said reduction reactor.

20. A method according to claim 7, further comprising feeding natural gas to a cooling zone of said reduction reactor.

21. A method according to claim 8, further comprising feeding natural gas to a cooling zone of said reduction reactor.

22. A method according to claim 9, further comprising feeding natural gas to a cooling zone of said reduction reactor.

23. A method according to claim 10, further comprising feeding natural gas to a cooling zone of said reduction reactor.

24. An apparatus for producing prereduced materials, including DRI, with improved reducing gas utilization, comprising:

a reduction reactor having a reduction zone with a gas inlet and a gas outlet;

a gas cooler in fluid communication with the gas outlet of said reduction zone;

a reducing gas heater in fluid communication with the gas inlet of said reduction zone;

first pumping device connected to said cooler and to said heater to recycle reducing gas from said gas outlet to said gas inlet;

conduit device for diverting a portion of the reducing gas effluent from said gas outlet of said reduction zone to second pumping device;

a separating device for producing a hydrogen rich output and a hydrogen lean output with the carbon dioxide content;

a conduit device communicating said second pumping device to said separating device; and

a conduit device to communicate from said hydrogen rich output of the separating device to between said first pumping device and the gas inlet of said reduction zone.

25. An apparatus according to claim 24, wherein said separating device is a chemical absorption unit.

26. An apparatus according to claim 24, wherein said separating device is a physical adsorption PSA or VPSA unit.